ARJUNA

JEE

LECTURE - 04

Mole Concept

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Q. The total number of Ca^{+2} ions and Cl^- ions in 111 gram of anhydrous $CaCl_2$ are -

$CaCl_2$

(A) NA, 2NA ✓

(B) NA, NA

(C) ✗ 2NA, NA

(D) None of these

$CaCl_2$

$Ca \Rightarrow 40$

$Cl \rightarrow 35.5 \times 2 = 71$

$\overline{111}$

total No. of Ca^{+2} = 1 × mole of $CaCl_2 \times N_A$

$= 1 \times \frac{111}{111} \times N_A$

$= N_A$

total No. of Cl^- = 2 × Mole of $CaCl_2 \times N_A$

$= 2\left(\frac{111}{111}\right) \times N_A$

$= \underline{2N_A}$

Q. Which has maximum number of atoms? (2003)

C → 12, Al-27, Fe = 56, Ag-108

A 24 g of C(12) $= \left(\frac{24}{12}\right) \times N_A = 2N_A$

B 27 g of Al(27) $\left(\frac{27}{27}\right) \times N_A = N_A$

C 56 g of Fe(56) $\rightarrow \left(\frac{56}{56}\right) \times N_A = 1 \times N_A$

D 108 g of Ag(108) $= \left(\frac{108}{108}\right) \times N_A = N_A$

40 Sec → Ans batao

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Q. The largest number of molecules is in (1979)

A 36 g of water (H_2O)

B 46 g of ethyl alcohol

$C_2H_5OH = 24+6+16 =$

C 28 g of CO

D 54 g of nitrogen pentaoxide (N_2O_5)

28
80
108

(A) $= \left(\frac{36}{18}\right) \times N_A = 2N_A$

(B) $\left(\frac{46}{46}\right) \times N_A = N_A$

(C) $= \left(\frac{28}{28}\right) \times N_A = 1N_A$

(D) $\left(\frac{54}{108}\right) \times N_A = \frac{N_A}{2}$

Q.

Fill in the Blanks:

The weight of 1×10^{22} molecules of $CuSO_4.5H_2O$ is _____ (1991)

Number $\xrightarrow[\div N_A]{}$ Mole $\xrightarrow[\times M.wt]{}$ weight

$$\frac{1\times10^{22}}{6.022\times10^{23}} = \frac{1}{6.022}\times10^{-1}\ \text{mole} \longrightarrow \frac{10^{-1}}{6.022}\times 249.5$$

$$= 4.14\ \text{gram}$$

$Cu = 63.5$

$S = 32.0$

$4O = 64.0$

$5H_2O = 90.0$

249.5

MOLE IN TERM OF VOLUME OF SUBSTANCE

$PV = nRT$ → ideal gas Equation (only applicable for ideal gas)

Where → P = pressure of gas (atm)

V = volume of gas (litre)

n = mole of gas (mole)

T = temperature (K)

R = universal gas const

Value of R

- 0.0821 atm · Litre $mole^{-1}$ K^{-1}
- 8.314 Joule $mole^{-1}$ K^{-1} (x)
- 1.99 ≅ 2 Calorie $mole^{-1}$ K^{-1} (x)

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$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{1 \times 0.0821 \times 273.5}{1} = \underline{22.4 \text{ litre}}$$

Value put → $n = 1$ mole

$P = 1$ atm $\simeq 1$ bar (1 bar $= 1.01325$ atm)

$R = 0.0821$

$T = 273.5$ K

1 mole gas contains 22.4 litre volume at $P = 1$ atm, $T = 273.5$ K

1 mole gas contains = 22.4 litre at S.T.P.

S.T.P. → Standard temp. and pressure

$$\begin{cases} 1 \text{ mole ideal gas} = 22.4 \text{ litre at S.T.P.} \\ 2 \text{ mole} \quad " \quad " = 2 \times 22.4 = 44.8 \text{ litre at S.T.P.} \\ \frac{1}{2} \text{ mole} \quad " \quad " = \frac{22.4}{2} = 11.2 \text{ litre at S.T.P.} \end{cases}$$

$$\text{No. of mole of gas} = \frac{\text{Vol. of gas at S.T.P. (litre)}}{22.4}$$

Q → Calculate mole of CO_2 gas, if 5.6 litre CO_2 gas present in container at S.T.P.

Soln ⇒ No. of mole of gas $= \frac{5.6}{22.4} = \frac{1}{4}$ mole $= 0.25$ litre

$C_{SD} = 11$

(a) No of mole $= \dfrac{\text{given Number}}{6.022 \times 10^{23}} = \dfrac{\text{wt. of subs (gram)}}{\text{M.wt}}$

→ Universal formula.
→ applicable all states of matter (gas, liq., solid)

(b) No of mole of gas $= \dfrac{\text{Vol. of gas at S.T.P (litre)}}{22.4}$

* only applicable for gas
* at S.T.P. Condition

1 mole gas = 22.4 litre at S.T.P.

P = 1 atm
T = 273.5 K

(c) Conversion →

1. wt. $\xrightarrow{\div \text{M.wt}}$ mole $\xrightarrow{\times 22.4 \text{ litre}}$ Vol. at S.T.P.

(2) Vol. of at S.T.P $\xrightarrow[\div 22.4 \text{ litre}]{}$ mole $\xrightarrow{\times N_A}$ Number

$0^\circ C = 273.5\ K$

$K = {}^\circ C + 273.5$

Q How many molecules of H_2 gas present in 11.2 litre volume at S.T.P.

(a) $\frac{N_A}{2}$ (b) $2N_A$ (c) $4N_A$ (d) None of these.

Soln ⇒ Vol. of gas at S.T.P

Mole of H_2 $= \frac{11.2}{22.4} = \frac{1}{2}$ mole

Number of H_2 molecules $= \frac{1}{2} \times N_A = \frac{N_A}{2}$

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Q. 2g of O_2 at STP occupies the volume

Ans batao → 20sec.

A 1.4 L

B 11.4 L

C 2.8 L

D 3.2 L

Soln → No. of mole $= \frac{2}{32} = \frac{1}{16}$ mole

Vol. of gas at S.T.P. = No. of mole of gas × 22.4 litre

$= \frac{1}{16} \times 22.4 = 1.4$ litre at S.T.P.

Q. Find volume of $CO_2(g)$ at STP if it weighs 88 g?
(Atomic mass of C and O are 12 g and 32 g)

A. 44.8 L

B. 22.4 L

C. 67.2 L

D. 89.6 L

$\frac{88}{44} = 2$ mole

$= 2 \times 22.4$ litre

$= \underline{44.8 \text{ litre}}$

20 Sec - Ans batao →

Q. The maximum number of molecules is present in

A. 15 L of H_2 gas at STP

B. 1.5 g of H_2 gas

C. 5 L of N_2 gas at STP

D. 5 g of O_2 gas

(A) $= \left(\frac{15}{22.4}\right) \times N_A$

(B) $= \left(\frac{1.5}{2}\right) \times N_A$

(C) $\left(\frac{5}{22.4}\right) \times N_A$

(d) $\left(\frac{5}{32}\right) \times N_A$

$C_{SD}=12$ **For liquid & solid ⇒ volume given hai Question**

$$d = \frac{\text{mass}}{\text{volume}}$$

① $\underset{\text{of subs.}}{\text{Mass}} = d \times V = d\left(\frac{g}{ml}\right) \times V(ml) = \text{gram}$

$= d\left(\frac{g}{\text{litre}}\right) \times V(\text{litre}) = \text{gram}$

② *** density of $H_2O = 1\frac{g}{ml}$ (Quest.^{n} me nahi diya jayega)

Q. How many mole of H_2O present in 22.4 litre H_2O at S.T.P.

(a) 1 mole

(b) 2 mole

(c) $\frac{1}{2}$ mole

(d) None of these.

Liquid.

P = 1atm

T = 273.5K or 0°C

B.P. = 100°C

Sol^n ⇒ Vol. of liquid H_2O = 22.4 litre

density of H_2O = $1\ \frac{g}{ml}$

Mass of H_2O = $d \times V = 1\ \frac{g}{ml} \times 22.4 \times 10^3\ ml$

= 22400 gram

mole of $H_2O = \frac{22400}{18}$ mole

Q. The number of water molecules present in a drop of water (volume 0.0018 ml) at room temperature is

A 6.023×10^{19}

C 1.084×10^{18}

B 4.84×10^{17}

D 6.023×10^{23}

⇒ 20 Sec Ans batao

Mass of H_2O = $d \times V = 1\frac{g}{ml} \times 0.0018 ml = 18 \times 10^{-4}$ gram

Mole of H_2O = $\frac{18 \times 10^{-4}}{18} = 10^{-4}$ mole

No: of H_2O molecules = $10^{-4} \times 6.022 \times 10^{23}$

6.022×10^{19}

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Q. The density of a liquid is 1.2 g/mL. There are 35 drops in 2 mL. The number of molecules in one drop are (molar mass of liquid = 70)

A $\left(\frac{1.2}{35}\right)$

B $\frac{1.2}{(35)^2}N_A$ ✓✓

C $\left(\frac{1}{35}N_A\right)^2 N_A$

D $1.2N_A$

35 drop = 2 ml

1 drop = $\frac{2}{35}$ ml (liquid)

mass of 1 drop = $1.2 \times \frac{1}{ml} \times \frac{2}{35}$ ml = $\frac{1.2 \times 2}{35}$ gram

Mole of molecules of liquid in drop = $\frac{\frac{1.2 \times 2}{35}}{70}$

= $\frac{1.2}{(35)^2}$ mole

No. of molecules of liq.

= $\frac{1.2}{(35)^2} \times N_A$

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Q. 1 cc N_2O at STP contains

1 ml N_2O at S.T.P. $N_2O \rightarrow$ Gas $\left(\frac{1}{22400}\right) \times 6.022 \times 10^{23}$

(A) $\frac{1.8}{224} X\,10^{22}$ Atoms

(B) $\frac{1.32}{224} X\,10^{23}$ electrons

(C) $\frac{6.02}{22400} X\,10^{23}$ Molecules

(D) All of the above

(A) No. of atoms $= (2+1) \times \left(\frac{1}{22400}\right) \times N_A = \frac{3}{22400} \times 6.022 \times 10^{23} = \frac{1.8}{224} \times 10^{22}$ atoms

(B) total No. of $\bar{e} = \left(\sum Z_i X_i\right) \times$ mole of $N_2O \times N_A =$

$= (7 \times 2 + 8 \times 1) \times \left(\frac{1}{22400}\right) \times 6.022 \times 10^{23}$

$= \frac{22 \times 6.022 \times 10^{23}}{22400} = \frac{1.32}{224} \times 10^{23}$ electrons

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Home work

- DPP-02
- DPP-03

Thank - You